DEVELOPMENT OF AUSTRALIAN CASE STUDIES IN STRATEGIC TECHNOLOGY MANAGEMENT: THE MICROSTILL OIL REFINERY

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ABSTRACT: National and international competition demands that Australian organisations become more competent at making the strategic technological decisions that impact their future in the international economy. A new subject unit, *Management of Technology* is now offered in the Master of Project Management and Master of Business Administration programs at the Queensland University of Technology. This cross-disciplinary subject provides students with a theoretical foundation and practical tools to improve the efficiency and competitiveness of technically oriented organisations. The provision of a theoretical background followed by applied case studies have been shown to be the most appropriate mode of learning for mature age students. In the first offerings of this subject during 1995 and 1996, American case studies were used. QUT has now supported the development of Australian case study packages for technology management through its Teaching and Learning Grants Scheme.
The first case developed—Inland Oil Refiners' *Microstill Project*—has been recently completed. The *Microstill Project* demonstrates technical niche market creation by a small dynamic Australian company. This paper reviews the need to develop Australian case material in Strategic Technology Management, discusses the case study documentation and supporting video developed, and application of the case study approach in this teaching initiative in QUT's MPM and MBA programs.

INTRODUCTION

Strategic management of technology is an emerging field of cross-disciplinary study integrating engineering, science and management principles. It focuses on the strategic process of identifying, choosing, and implementing the most effective means of attaining compatibility between internal skills and resources of an organisation and its competitive, economic and social environment. More effective management of technology is crucial to the survival of organisations in today's changing world. National and international competition demands that Australian organisations become more competent in making the strategic technological decisions that impact their future and this nation's prosperity in the international economy.

Renown Harvard Business School Professor Michael Porter (1980, 1985) highlights technology as being the single most important factor in changing the rules of business competition. *"Technology has the power to change the basic way that markets operate,"* he says.

Management of Technology is an elective unit in the Master of Project Management and Master of Business

Administration programs at Queensland University of Technology. The average age of this student cohort is 36 years, with 15 years' industry experience. Students are sourced from a variety of industries and initial disciplinary areas—with engineering, architecture, construction and business backgrounds being dominant. They typically have middle management responsibilities in their employment.

Management of Technology provides students with a theoretical foundation and a set of tools and concepts to improve the efficiency and competitiveness of technically oriented organisations. It builds on students' existing management and technical experiences. The unit includes the following topics:

- Technology and competitive advantage
- Technological trends and forecasting
- Invention, innovation and commercialisation
- Product development cycle time reduction
- Acquisition of technology
- Human skill component of technological capabilities
- Managing the technical function
- Role of the manager as leader, champion, motivator, and facilitator.

THE CASE STUDY APPROACH

The provision of a theoretical background followed by applied case studies has been shown to be the most appropriate mode of learning for mature age students. Knowles, for example, makes a critical observation about the character of the adult learner:

> *Adults have a deep need to be self-directing; therefore, the role of the teacher is to engage in a process of mutual inquiry with them rather than to transmit his or her knowledge to them and then evaluate their conformity to it.* (1993:32)

His clear opinion is that the best method of teaching adults is group discussion, and that learning efforts should be organised around "projects ... defined as *a series of related episodes* (1990:41). Therefore, a series of case studies was sourced for use throughout the subject. Interestingly, the roots of the case study method may be traced back as far as Socrates, who would pose a question or dilemma after describing a situation, and invite his students to explore its characteristics and possible resolutions. Print (1993:120) states that the case material may be contradictory and incomplete, creating an environment guaranteed to engage inquiry and imaginative minds. He recommends the trainer act as a moderator to probe and test the analysis done by the student, placing the responsibility on the student to arrive at a positive learning outcome.

In the first offerings of this subject during 1995 and 1996, the following case studies from the Stanford Graduate School of Business and Harvard Business School were used.

- Associated Instruments Corporation: Analytic Instruments Division (Stanford University Graduate School of Business [Case #S-PD-5])
- The Rogers Corporation: Electroluminescent Lamps (Harvard Business School [Case #5-688-058])
- Crown Cork and Seal Company Inc. (Harvard Business School [Case #378-024])
- Mod IV Product Development Team (Harvard Business School [Case #9-491-030])
- Hitachi Seiki (Harvard Business School [Case #9-668-104]), and
- Hewlett-Packard: Corporate, Group and Divisional Manufacturing (Harvard Business School [Case N9-691-001]).

Though these cases are very useful, student feedback is critical of their American bias—in both a cultural and business perspective—and some are very dated. For example, the Crown Cork and Seal case was published in 1977. Few suitable management of technology cases exist through Stanford Graduate School of Business or Harvard Business School publications. The cases are also expensive. Introduction of the new unit *Management of Technology* has focussed attention in the School of Construction Management on this high cost and often inappropriate foreign case documentation.

FOCUS ON IMPROVEMENT

QUT has now supported the development of Australian case studies for technology management through their internal Teaching and Learning Grants Scheme. Industry collaboration through student groups (comprising middle to senior managers) is being used to develop quality documented case studies, including video support and teacher guides. The funding will provide the resources to have the industry case studies refined to a standard for publication and supported by video presentations to be used as professional multi-media learning tools. No other collection of Australian cases focussed on this emerging strategic technology management theme is publicly available.

This exciting initiative is supportive of the development of flexible learning and teaching opportunities in the Masters programs. This project will also promote student participation in their own learning and *deep learning* through the use of interactive case study teaching. The increased local context of new cases is also expected to have a significant positive impact on student learning, given the local and readily identifiable nature of the Australian-produced case study packages.

A further key outcome of the development of these case studies is the enhancement of industry links with the university. Case study development requires close cooperation with senior managers of firms, and a continuing commitment over a period approaching 12 months to provide access and information to the QUT Project Coordinator, students and research assistants. This close linking can provide the foundation for long-term relationships. The importance of industry involvement is reinforced by

Murthy (1996, p1) who states that the success of such programs is *critically dependent on the role that industry plays.* This is because effective technology management requires *blending theory with practice, team approach involving inter-disciplinary teams and live case studies dealing with real contemporary issues.*

The successful Teaching and Learning Grant obtained during 1995 allowed a group of selected Masters students to be employed to upgrade the quality and breadth of coverage of select submitted student group assignments. The goal was to produce high quality Australian case study material of an international standard. The public selection of the case studies suitable for upgrading is made from those submitted by all students enrolled in this unit, thereby providing motivation to strive for recognition with a high quality initial submission. This approach was used during 1996 with excellent results.

The progressive substitution of US-based cases with Australian cases will improve the relevance of the source material and simultaneously reduce reliance on costly overseas supplied cases. It is planned that QUT's case study packages, developed through this process, will soon be available to other universities. Initially, case studies are being produced from upgraded assignments submitted in Brisbane. However, expansion of this program to include the School of Construction Management's offshore students in Singapore and Kuala Lumpur will provide a source of regionally-useful Management of Technology case studies.

A second phase of this project is for the authors of the refined case studies and their industry partners to return the following year (and in subsequent years) to adjudicate on the class evaluation of the case and present the *real-life* sequel to the case. In this way, the real world relevance of class teaching is significantly enhanced. Progressive case updates may also be incorporated if considered relevant.

THE MICROSTILL CASE STUDY PACKAGE

The student group assignment selected for upgrading during 1995 was *The Microstill Project*. Inland Oil Refineries (IOR) is a small Brisbane-based company successfully competing in the petroleum industry—an important sector dominated by large multinational companies. IOR have become market leaders with their mini-petroleum refinery called the Microstill. This case illustrates technical development strategies and management approaches which Inland Oil Refiners have used to develop an innovative micro-oil refinery for domestic and international sales. A series of questions are posed as to how IOR can maintain their competitive advantage and tackle its newest venture to supply modularised refinery units to Russian Siberia. The Microstill Project demonstrates technical niche market creation by a small dynamic Australian company.

The case study development project encompassed three components:

- case study documentation for class distribution
- supporting video, and
- teaching guide for use by lecturers/facilitators.

The *case study documentation* comprises approximately 25 pages describing the IOR Microstill development project, and business opportunities and constraints existing in the oil refining business. It describes the contextual business environment in which decisions regarding future expansion of the firm's capacity to capitalise on potential export growth are made. It concludes with a series of questions for the students to discuss in their respective groups. Students then present their analysis and recommendations to the class in the following class session.

The *supporting video* (19 minutes duration) dramatises the product development process employed by IOR. This product development has been project-driven commencing with a micro refinery at Eromanga, near Quilpie in South West Queensland. It then progressed further to staged development as industry market opportunities were identified—initially in the highlands of Papua New Guinea, then Alice Springs, and now potentially Russian Siberia. Interviews with key players in the development process, including the two company founding directors (one a chemical engineer, the other a transport entrepreneur) and industry clients and consultants, provides a human and social context of technology development. The video concludes with Nommensen and Bonnar (the IOR Directors) pondering their options in undertaking to supply a multi-million dollar Microstill order into Russian Siberia.

The *teaching guide* is for direct use by the subject lecturer/facilitator. It reviews a series of technology management frameworks including:

- Burgelman and Rosenbloom's *Evolutionary Process Framework for Technology Strategy;*
- Hayes and Wheelwright's *Product Process Matrix;*
- Viljoen's *Customer Buying Decision Process Framework* and *Competitive Strategy Alternatives;*
- Porter's *Five Force Industry Analysis* and *Technology Adoption Guidelines;*
- Belbin's *Team Typing;*
- Twiss and Goodridge's *T-Shaped Management Paradox;*
- Clark's *Innovations Map;* and
- Hampson's *Technology Strategy Framework.*

The teaching guide also provides a series of suggested assignment questions and lecture-session prompts to assist in promoting lively student participation and constructive class discussion.

CONCLUSIONS

No other published source of Australian case studies for Management of Technology is known. The development of Australian case studies in the School of Construction Management at QUT will provide the first known publication-standard case studies in this area. The Inland Oil Refiners *Microstill Project* is the first deliverable in this series of research and teaching initiatives. A larger grant has been successfully obtained for development of a further two cases in 1996 and plans are in hand to extend this during 1997. A series of project team meetings have been held, scripting is complete and filming is planned for the November - December 1996 period. The following projects comprise the 1996 developments:

- Fruit and vegetable packing and transportation system—facilitating the delivery of easily bruised fruit and vegetables direct from farm to supermarket, and
- Electronic door-opener for the disabled—an electronic control system coupled with pneumatic mechanisms to provide ease of access through doorways in public buildings.

Case study teaching for Management of Technology has already proven to be of great value. Feedback from this series of learning experiences has been enthusiastic, with the following comments recorded from Brisbane-based students on the QUT Student Evaluation of Teaching being typical, *"Good subject, very relevant, enjoyable and stimulating,"* and *"Case study method is an excellent process."* Singapore students have also embraced the concept of this approach and commented, *"Case studies are excellent—they stimulate thinking and encourage participation,"* and *"Lively teaching and intermingling with class allows students to have far greater interest in the subject."*

Progressive substitution of dated and expensive, foreign-produced cases will allow a more appropriate and balanced blend of national and international course material to complement other teaching methods in this Management of Technology initiative in QUT's School of Construction Management.

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